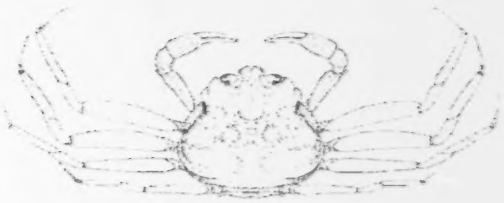


Newfoundland and Labrador Snow Crab

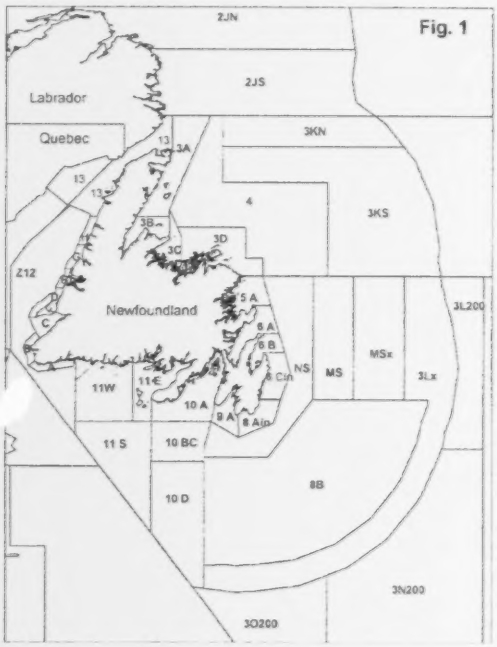
Background

Snow crab occur over a broad depth range in the Northwest Atlantic from Greenland to the Gulf of Maine. In Newfoundland and Labrador there is no evidence to indicate distinct stocks. Commercial sizes are most common on mud or mud/sand bottom while smaller crabs are also common on harder substrates. The snow crab diet includes clams, polychaete worms, brittle stars and other crustaceans. Predators include various groundfish, other snow crabs and seals.

Males continue to molt until they develop large claws, which enhances their ability to mate. This terminal molt may occur over a wide size range (40-110 mm carapace width (CW). Females cease molting when they first spawn, at smaller sizes (40-75 mm CW). Snow crab may live 5-6 years after the terminal molt.

The minimum legal size in the fishery is 95 mm CW. This regulation excludes females from the fishery while generally ensuring a portion of the adult males in the population remain available for reproduction.

The fishery began in 1968 and was limited to NAFO Divisions 3KL until the mid 1980's. It has since expanded throughout Divisions 2J3KLNOP4R and is prosecuted by several fleets. The resource declined during the early 1980's but then recovered and has remained very large throughout the 1990's. Management of the increasingly diverse fishery led to the development of 41 quota-controlled areas (Fig. 1) with over 3500 licence/permit holders under enterprise allocation by 1999. It is not possible to provide scientific information at this fine scale of management.



Summary

Division 2J3KLNO

- Landings increased from 6,000 t in 1987 to 44,400 t in 1998. They further increased by 33% to 59,600 t in 1999 due to TAC increases. TAC's have been reached each year.
- The number of trap hauls more than doubled from 1987 to 1998. It further increased by 35% in 1999. Effort has been broadly distributed in recent years indicating that commercial concentrations exist over a broad area. Prospects for further expansion are limited.
- Commercial catch rates increased in the late 1980's and early 1990's and have

104-02228/

remained high in recent years. Annual changes in fishing practices and areas may affect CPUE and introduce uncertainty as to the reliability of CPUE as a valid indicator of trends in biomass.

- The fall bottom trawl surveys, which are conducted near the end of the fishery, indicate that the resource is broadly distributed throughout the survey area. This reflects a large area of suitable habitat.

- The ratio of the commercial catch to an exploitable biomass index, which was projected from the fall survey of the previous year, increased from 0.40 in 1997 and 1998 to 0.53 in 1999. Therefore, exploitation increased in 1999 but the absolute rate is unknown.

- The residual biomass index of crabs 95 mm and larger, based on fall surveys, which was stable during 1996-1998, decreased from 85,000 t in 1998 to 47,000 t in 1999. The fall survey biomass index of 76-94 mm small-clawed males (immediate prerecruits) decreased by 54% from 1998 to 1999. A decrease in the exploitable biomass is projected for 2000 due to the 45% decrease in residual biomass in 1999 and the projected decrease in recruitment for 2000.

- Reliability of the fall biomass index of 40-75 mm small-clawed males is uncertain. Therefore, there is uncertainty regarding their contribution to recruitment beyond 2000. The fall biomass index of males smaller than 40 mm has declined since 1996. This may indicate a series of weak year classes that is expected to provide poor recruitment in the longer term.

- The fall biomass index of mature females has also been declining since 1996.

- The cause of declines in commercial biomass and immediate recruitment includes effects of fishing.

- Declines in abundance of small males and mature females are not directly related to the fishery. The cause may include bitter crab disease, environmental warming, and density-dependent effects.

Subdivision 3Ps

- Landings increased from 600 t when the fishery began in 1987 to 6,600 t in 1998. They further increased by 20% to 7,900 t in 1999 due to TAC increases. TAC's have been reached each year.

- The commercial catch rate was relatively stable during 1987-1991 and increased steadily through the 1990's.

- Resource status and future prospects are uncertain because of the lack of reliable survey data.

Division 4R

- Landings increased from 650 t when the fishery began in 1994 to 1,060 t in 1998. They further increased by 52% to 1,610 t in 1999 due to TAC increases. TAC's have not been reached in some years.

- The commercial catch rate in Division 4R has remained at a lower level than in other divisions.

- Resource status and future prospects are uncertain because of the lack of any fishery-independent data.

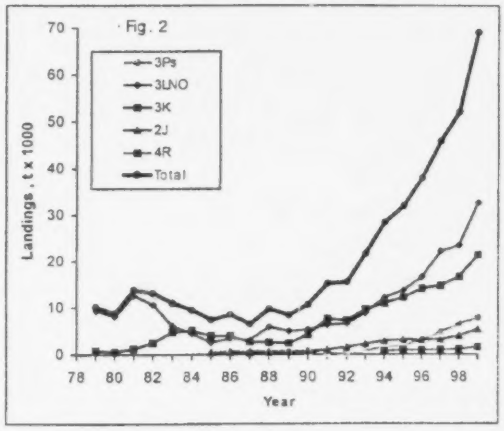
The Fishery

The fishery began in Trinity Bay in 1968. Initially, crabs were taken as gillnet by-catch but within several years there was a directed trap fishery in inshore areas along the northeast coast of Div. 3KL during spring through fall. Until the early 1980's the fishery was prosecuted by approximately 50 vessels, limited to 800 traps each. In 1981 fishing was restricted to the NAFO division where the licence holder resided. During 1982-87 there were major declines in the resource in traditional areas in 3K and 3L while new fisheries started in 2J, 3Ps, 4R and offshore 3K. Since the late 1980s, the resource has increased in all areas.

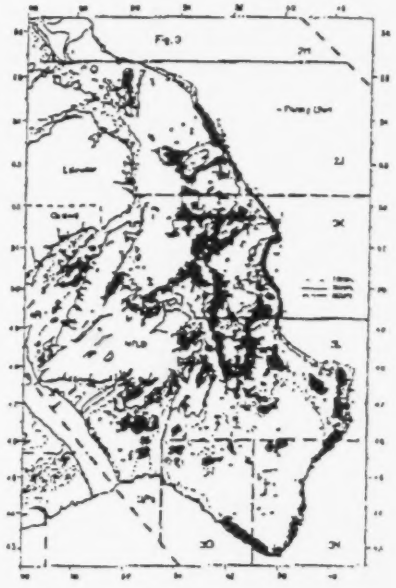
Licences supplemental to groundfishing were issued in 3K in 1985, in 3L in 1987 and in 2J in the early 1990's. Since 1989 there has been a further expansion in the offshore. Temporary seasonal permits for vessels <35 ft. were introduced in 1995. There are now several fleets and more than 3500 licence or permit holders.

In the late 1980's quota control was initiated in all management areas of each division. The season was also shortened and timed differently for the two fleets (fulltime and supplementary). A dockside monitoring program designed and managed by fishers to control quotas and quality was initiated in 1994. All fleets have designated trap limits, quotas, trip limits, fishing areas within divisions, and differing seasons.

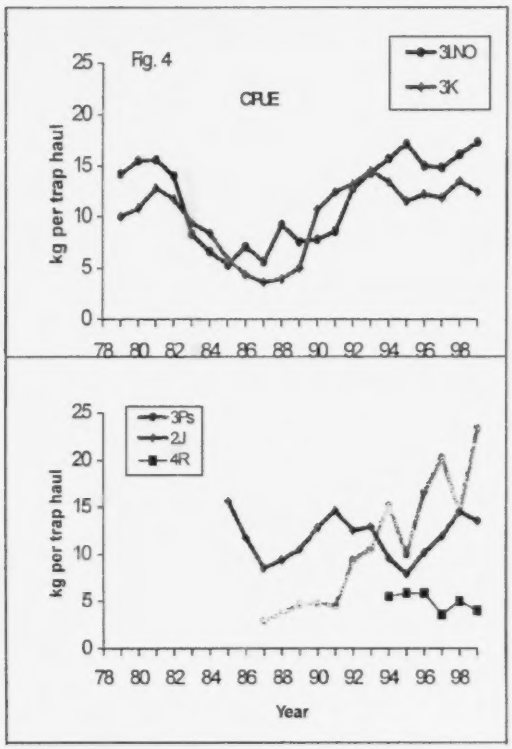
Landings have been increasing steadily from the late 1980's to 52,000 t in 1998. They further increased by 33% to a high of 69,200 t in 1999 (Fig. 2). Most of this increase came from Div. 3KLNO and largely from expansion of the fishery to offshore areas.



Effort, as indicated by estimated trap hauls, has more than doubled from 1987 to 1998. It further increased by 35% in 1999. New effort is primarily due to vessels <35 feet with temporary seasonal permits. Effort has been broadly distributed in recent years (Fig. 3) indicating that commercial concentrations exist over a broad area. Spatial expansion in 1999 resulted in increased effort along the slope throughout Div. 2J3KLNO.



Overall, recent catch rates have remained high, except for Div. 4R (Fig. 4), although they have been quite variable among individual management areas.



Div. 2J: Landings increased to 5,500 t in 1999 from 4,100 t in 1998. Catch rate, which had increased steadily during 1996-1998, declined slightly in 1999 but remained higher than in 1997.

Div. 3K: Landings increased to 21,500 t in 1999 from 16,800 t in 1998. Catch rate declined slightly in 1999 but remained high, within the 12 to 14 kg/trap haul range of the last several years. An exploratory fishery was initiated in 1997 to determine the commercial potential of offshore grounds deeper than 550 m. This was expanded in 1998 and 1999. Instances of Bitter Crab Disease (BCD) were again reported by many fishers and dock-side monitors.

Div. 3LNO: Landings increased to 32,700 t in 1999, from 23,500 t in 1998. Catch rate increased in 1999 for the second consecutive year, to a high 17.3 kg/trap haul, comparable to the level achieved in 1995.

Subdiv. 3Ps: Landings increased to 7,900 t in 1999 from 6,600 t in 1998. The commercial catch rate increased steadily through the 1990's. It increased further to a high of 23.4 kg/trap haul in 1999. An unregulated fishery developed adjacent to area 10A (Fig. 1) in 1996. This fishery, prosecuted by 13 vessels from St. Pierre and Miquelon, landed 859 t in 1999.

Div. 4R: Landings increased to 1,610 t in 1999 from 1,060 t in 1998. TAC's have not been reached in some years. The commercial catch rate has remained relatively stable at a lower level than in other divisions.

Resource Status

Div. 2J3KLNO

Commercial Catch Rates

Because of numerous changes in fishery regulations and fishing practices, slight year-to-year changes in catch rates have not been used to infer changes in stock status. However, it is possible to interpret catch rates in the context of longer-term trends. Commercial catch rates in the 1990's were considerably higher than in the 1980's, and have generally remained stable through 1999. Expansion of fishing effort to new areas and other changes in fishing practices may have helped maintain catch rates in 1999. Late-season catch rates were substantially lower in 1999 than in 1998 in Div. 2J3K, likely reflecting a reduced residual biomass in 1999.

Inshore Trap Surveys

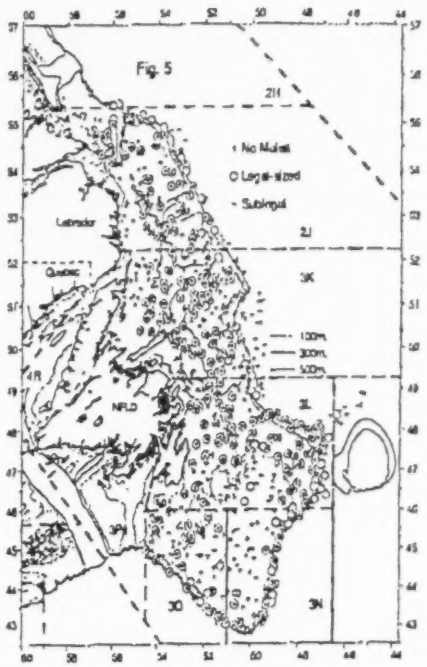
Research surveys using commercial and small-meshed traps have been carried out

during different seasons in three crab management areas in Div. 3L since the early 1980's; 5A–Bonavista Bay, 6B-Conception Bay, and 6C-Northeast Avalon (Fig.1). Sampling with a small shrimp trawl has been conducted since 1996 as well. Survey catch rates of legal-sized crabs from commercial traps reflect the long-term trend in commercial catch rates. Preliminary analysis of the shrimp trawl data indicates that this gear can effectively catch very small crabs. A longer time series is required in order to evaluate its utility as an early indicator of relative year-class strength.

A Div. 3K research survey, also using commercial and small-meshed traps, has been conducted in the White Bay-Notre Dame Bay area (Area 3B-D, Fig.1) during September of 1994-1999. Survey results showed a regular increase in catch rate of intermediate-sized (40-75 mm) males in shallow strata during 1994-1998, followed by a decrease in 1999.

Bottom Trawl Surveys

Data from fall multispecies bottom trawl surveys in Div. 2J3KLNO during 1995-1999 were used. Surveys were conducted near the end of the fishing season. They sampled the entire size range and an extensive area of snow crab distribution, not including inshore strata in 1995 and 1999. Males were broadly distributed throughout the survey area in 1999 (Fig. 5). They were virtually absent on the slope of the continental shelf deeper than about 800 m, and across most of the shallow southern Grand Bank. Legal-sized crabs predominated in catches at greatest depths, including near the shelf edge, smaller crabs predominated in shallower water, especially near the coast, and a mixture of sizes occurred at intermediate depths over most of the shelf.

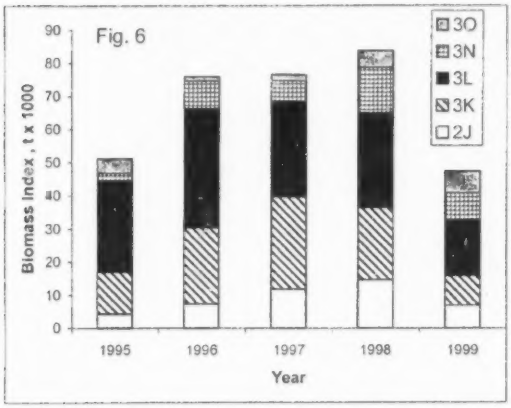


The 2J3KLNO residual (post-fishery) biomass index of legal-sized crabs, based on fall surveys, which was stable during 1996-1998, decreased from 85,000 t in 1998 to 47,000 t in 1999.

The ratio of the 2J3KLNO commercial catch to an exploitable biomass index, which was projected from the fall survey of the previous year, increased from 0.40 in 1997 and 1998 to 0.53 in 1999. Therefore, exploitation increased in 1999 but the actual rate is unknown.

The fall survey biomass index of 76-94 mm small-clawed males (immediate prerecruits) decreased by 54% from 1998 to 1999.

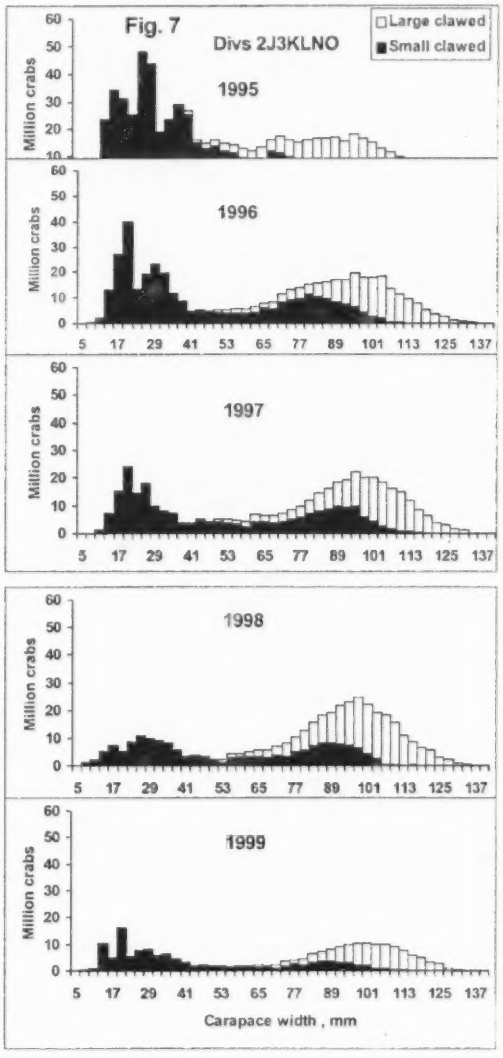
A decrease in the exploitable biomass is therefore projected for 2000 due to the 45% decrease in residual biomass in 1999 (Fig. 6) and the projected decrease in recruitment for 2000.



Size distributions from Div. 2J3KLNO fall surveys reflect the stable commercial (crabs of 95 mm and larger) biomass levels during 1996-1998 and the decrease in 1999 (Fig. 7). They also reflect the reduced biomass of prerecruits (small-clawed males of 76-94 mm) and hence the reduced recruitment to legal size projected for 2000. Males of 40-75 mm are not well-represented in survey catches and so there is uncertainty regarding their expected contribution to recruitment beyond 2000. Abundance of male crabs smaller than 40 mm has declined since 1996. This may indicate a series of weak year classes that is expected to provide poor recruitment to the fishery in the longer term.

There appears to have been heavy natural mortality among small crabs of both sexes over the past several years. Reduced abundance of small males is already negatively impacting recruitment to the fishery. A decline in abundance of females has resulted in reduced egg production but implications of this for future recruitment are unknown. These declines are not directly related to the fishery.

There has been a broadly distributed incidence of bitter crab disease (BCD) during the late 1990's. This disease, which is fatal to crabs, appears to be acquired during molting. The fall bottom trawl surveys indicate that it occurs in Div. 2J3KL, especially in small crabs of both sexes, but is virtually absent in Div. 3NO. Although its incidence appears to remain low overall, the catchability of infected crabs by commercial and research sampling gears is unknown. Therefore the prevalence of this disease in the population may be underrepresented in samples. It is possible that this disease has contributed to declining recruitment.



Subdiv. 3Ps

The commercial catch rate was relatively stable during 1987-1991 but increased steadily through the 1990's.

Bottom trawl surveys are conducted in spring when molting and mating occur. Results are unreliable because the population is incompletely available to the survey trawl. This is related to the survey being carried out during spring molting and mating season and the resulting poor representation of small-clawed crabs.

Resource status and future prospects are uncertain because of the lack of reliable survey data.

Div. 4R

The commercial catch rate has remained relatively stable at a lower level than in other divisions.

Resource status and future prospects are uncertain because of the lack of research data for this division.

Sources of Uncertainty

There is considerable uncertainty regarding the utility of commercial catch rate as a valid indicator of trends in biomass. There is uncertainty associated with unknown effects of changes in abundance versus changes in fishing practices (eg. area fished, fishing season, soak time) on trends in commercial catch rates.

There is also uncertainty regarding effects of fishing on soft-shelled, undersized, and small legal-sized (highgraded) crabs that are discarded. Poor handling practices results in additional but unquantified fishing mortality on discarded crabs.

There is uncertainty in biomass indices due to wide confidence intervals. This uncertainty is greatest for Divisions 3NO and Subdivision 3Ps and is related to aggregation of the resource in these areas. Additional uncertainty in Subdivision 3Ps is related to the survey being carried out during the spring molting and mating season and the related poor representation of small-clawed crabs in survey catches.

The catchability of the survey trawl is unknown so absolute biomass and exploitation rate are also unknown. Variation in biological parameters including proportions molting, growth rate, and size at terminal molt, represents another source of uncertainty.

There is uncertainty regarding the recent decline in abundance of sublegal-sized crabs, especially those smaller than 40 mm. The cause is unclear but it is not directly related to the fishery. It likely involves a complex interaction of factors that may include bitter crab disease, density-dependent processes, and environmental effects.

Cannibalism on settling year classes has been proposed as a density-dependent mechanism which results in successive weak year classes and an intrinsic oscillation in recruitment. However it is unknown how important cannibalism may be as a source of mortality because there are no data on snow crab diet specific to this area.

Although cold conditions are believed to be favourable, there is considerable uncertainty regarding effects of warming since 1995. Environmental variation may affect distribution, behavior, growth, and catchability but it is unclear how it may affect the various life-history stages and subsequently impact recruitment.

Outlook

A decrease in the exploitable biomass is projected for 2000 due to the decrease in residual biomass in 1999 and the projected decrease in recruitment for 2000.

The fall biomass index of 40-75 mm small-clawed males is uncertain. Therefore, there is uncertainty regarding their contribution to recruitment beyond 2000. The fall biomass index of males smaller than 40 mm has declined since 1996. This may indicate a series of weak year classes that is expected to provide poor recruitment in the longer term.

Commercial fishery data for Subdiv. 3Ps indicate a high commercial biomass. Resource status and future prospects are uncertain because of the lack of reliable survey data.

The commercial catch rate in Div. 4R has remained at a lower level than in other divisions. There are no research data and so current resource status and future prospects are uncertain.

Management Considerations

High catch levels will not be sustainable if the exploitable biomass in Div. 2J3KLNO declines, as expected, over the next several years. It will become particularly important, at reduced biomass levels, to reduce resource wastage. Emphasis should be placed on minimizing both discard levels and mortality rates on discarded crabs.

For more Information:

Contact: Earl G. Dawe
Science Branch
Dept. of Fisheries and Oceans
Newfoundland Region
P.O. Box 5667
St. John's, NF A1C 5X1

Tel: (709) 772-2076
Fax: (709) 772-4105
E-Mail: Dawe@athena.nwafc.nf.ca

Contact: David M. Taylor
Science Branch
Dept. of Fisheries and Oceans
Newfoundland Region
P.O. Box 5667
St. John's, NF A1C 5X1

Tel: (709) 772-2077
Fax: (709) 772-4105
E-Mail: Taylor@athena.nwafc.nf.ca

References

Dawe, E.G., D. Kulka, H.J. Drew, P.C. Beck, and P.J. Veitch (in prep). Status of Newfoundland and Labrador Snow Crab in 1999.

Taylor, D.M., and P.O'Keefe (in prep). Assessment of the 1999 Newfoundland and Labrador Snow Crab fishery.

This report is available from the:

Stock Assessment Regional Office
Newfoundland Region
P.O. Box 5667
St. John's NF A1C 5X1
Phone Number (709) 772-2027/4355
Fax Number (709) 772-6100
e-mail address tillmanj@dfo-mpo.gc.ca
Internet address http:/www.dfo-mpo.gc.ca/csas

ISSN 1480-4913

La version française est disponible à l'adresse ci-dessus.

Correct citation for this publication

DFO, 2000. Newfoundland and Labrador snow crab. DFO Science Stock Status Report C2-05 (2000).